

Exhibit A WORK STATEMENT

TECHNICAL TASK LIST

Task #	CPR	Task Name
1	N/A	Administration
2		Modeling and Analysis
3		Data Center Audit and Energy Usage Baseline
4		Procure and Install VFDs
5		Install and Commission DASH System
6		Airflow Management
7	X	Measurement and Verification (M&V) Tests
8		Technology Transfer Activities

KEY NAME LIST

Task #	Key Personnel	Key Subcontractor(s)	Key Partner(s)
1-2	Brian Fortenbery		
3-8	Dennis Symanski		

GLOSSARY

Specific terms and acronyms used throughout this scope of work are defined as follows:

Term/ Acronym	Definition
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
CPR	Critical Project Review
CRAC	Computer Room Air Conditioner
DASH	Datacenter Automation Software and Hardware
DX	Direct Expansion refrigerant based air conditioning units
Energy Commission	California Energy Commission
M&V	Measurement and Verification
PAC	Project Advisory Committee
PIER	Public Interest Energy Research
RD&D	Research, Development and Demonstration
VFD	Variable Frequency Drives

Problem Statement:

The current Computer Room Air Conditioner (CRAC) equipment, especially Direct Expansion refrigerant based air conditioning (DX) units, does not use variable speed fan control. The often-cited argument is that the cooling loads in data centers remain relatively unchanged and variable frequency drives (VFD) are not economically justified. This argument, however, was debunked in 2004 in a large-scale enterprise data center

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for Oracle in Austin, TX. In this installation, VFDs on the chilled-water CRAC units were implemented; the actual payback period was observed to be less than 6 months as compared to an estimated payback period of 19 months. (Ref: Martin, M., Khattar, M. and Germagian, M. High Density Heat Containment. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Journal, December 2007. pp 38-43.

Goals of the Agreement:

The goal of this Agreement is to demonstrate that airflow management with the retrofit of variable speed control on existing DX CRAC units is effective and efficient.

Objectives of the Agreement:

This Agreement has two main objectives. They are as follows:

1. Demonstrate reliable operation of variable speed retrofits on DX CRAC units.
2. Demonstrate, monitor and verify the savings achievable with distributed wireless network of temperature sensors for airflow management and control of the variable speed fans in DX CRAC units.

Objective 1 will investigate and demonstrate the resolution of issues involved in converting constant speed evaporator fans to variable speed operation. Known issues are over dehumidification, potential condensate freezing on cooling coils, and unsatisfactory control of server inlet air temperature. The control schemes will address all of these issues. Objective 2 will illustrate the savings potential of retrofitting DX cooling units in data centers with variable frequency drives.

TASK 1 ADMINISTRATION

Task 1.1 Attend Kick-off Meeting

The goal of this task is to establish the lines of communication and procedures for implementing this Agreement.

The Recipient shall:

- Attend a "Kick-Off" meeting with the Commission Project Manager, the Grants Officer, and a representative of the Accounting Office. The Recipient shall bring its Project Manager, Agreement Administrator, Accounting Officer, and others designated by the Commission Project Manager to this meeting. The administrative and technical aspects of this Agreement will be discussed at the meeting. Prior to the kick-off meeting, the Commission Project Manager will provide an agenda to all potential meeting participants.

The administrative portion of the meeting shall include, but not be limited to, the following:

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- Discussion of the terms and conditions of the Agreement
- Discussion of Critical Project Review (Task 1.2)
- Match fund documentation (Task 1.6)
- Permit documentation (Task 1.7)

The technical portion of the meeting shall include, but not be limited to, the following:

- The Commission Project Manager's expectations for accomplishing tasks described in the Scope of Work
- An updated Schedule of Products
- Discussion of Progress Reports (Task 1.4)
- Discussion of Technical Products (Product Guidelines located in Section 5 of the Terms and Conditions)
- Discussion of the Final Report (Task 1.5)

The Commission Project Manager shall:

- Designate the date and location of this meeting.

Recipient Products:

- Updated Schedule of Products (no draft)
- Updated List of Match Funds (no draft)
- Updated List of Permits (no draft)

Commission Project Manager Product:

- Kick-Off Meeting Agenda (no draft)

Task 1.2 Critical Project Review (CPR) Meetings

The goal of this task is to determine if the project should continue to receive Energy Commission funding to complete this Agreement and to identify any needed modifications to the tasks, products, schedule or budget.

CPRs provide the opportunity for frank discussions between the Energy Commission and the Recipient. CPRs generally take place at key, predetermined points in the Agreement, as determined by the Commission Project Manager and as shown in the Technical Task List above. However, the Commission Project Manager may schedule additional CPRs as necessary, and any additional costs will be borne by the Recipient.

Participants include the Commission Project Manager and the Recipient and may include the Commission Grants Officer, the Public Interest Energy Research (PIER) Program Team Lead, other Energy Commission staff and Management as well as other individuals selected by the Commission Project Manager to provide support to the Energy Commission.

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The Commission Project Manager shall:

- Determine the location, date, and time of each CPR meeting with the Recipient. These meetings generally take place at the Energy Commission, but they may take place at another location.
- Send the Recipient the agenda and a list of expected participants in advance of each CPR. If applicable, the agenda shall include a discussion on both match funding and permits.
- Conduct and make a record of each CPR meeting. One of the outcomes of this meeting will be a schedule for providing the written determination described below.
- Determine whether to continue the project, and if continuing, whether or not modifications are needed to the tasks, schedule, products, and/or budget for the remainder of the Agreement. Modifications to the Agreement may require a formal amendment (please see the Terms and Conditions). If the Commission Project Manager concludes that satisfactory progress is not being made, this conclusion will be referred to the Energy Commission's Research, Development and Demonstration (RD&D) Policy Committee for its concurrence.
- Provide the Recipient with a written determination in accordance with the schedule. The written response may include a requirement for the Recipient to revise one or more product(s) that were included in the CPR.

The Recipient shall:

- Prepare a CPR Report for each CPR that discusses the progress of the Agreement toward achieving its goals and objectives. This report shall include recommendations and conclusions regarding continued work of the projects. This report shall be submitted along with any other products identified in this scope of work. The Recipient shall submit these documents to the Commission Project Manager and any other designated reviewers at least 15 working days in advance of each CPR meeting.
- Present the required information at each CPR meeting and participate in a discussion about the Agreement.

Commission Project Manager Products:

- Agenda and a list of expected participants (no draft)
- Schedule for written determination (no draft)
- Written determination (no draft)

Recipient Product:

- CPR Report(s) (no draft)

Task 1.3 Final Meeting

The goal of this task is to closeout this Agreement.

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The Recipient shall:

- Meet with Energy Commission staff to present the findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this Agreement.

This meeting will be attended by, at a minimum, the Recipient, the Commission Grants Office Officer, and the Commission Project Manager. The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be two separate meetings at the discretion of the Commission Project Manager.

The technical portion of the meeting shall present an assessment of the degree to which project and task goals and objectives were achieved, findings, conclusions, recommended next steps (if any) for the Agreement, and recommendations for improvements. The Commission Project Manager will determine the appropriate meeting participants.

The administrative portion of the meeting shall be a discussion with the Commission Project Manager and the Grants Officer about the following Agreement closeout items:

- What to do with any equipment purchased with Energy Commission funds (Options)
- Energy Commission's request for specific "generated" data (not already provided in Agreement products)
- Need to document Recipient's disclosure of "subject inventions" developed under the Agreement
- "Surviving" Agreement provisions, such as repayment provisions and confidential Products
- Final invoicing and release of retention
- Prepare a schedule for completing the closeout activities for this Agreement

Products:

- Written documentation of meeting agreements (no draft)
- Schedule for completing closeout activities (no draft)

Task 1.4 Monthly Progress Reports

The goal of this task is to periodically verify that satisfactory and continued progress is made towards achieving the research objectives of this Agreement on time and within budget.

The objectives of this task are to summarize activities performed during the reporting period, to identify activities planned for the next reporting period, to identify issues that

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may affect performance and expenditures, and to form the basis for determining whether invoices are consistent with work performed.

The Recipient shall:

- Prepare a Monthly Progress Report which summarizes all Agreement activities conducted by the Recipient for the reporting period, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. Each progress report is due to the Commission Project Manager within 10 days of the end of the reporting period. The recommended specifications for each progress report are contained in Exhibit A, Attachment A-2.

Product:

- Monthly Progress Reports (no draft)

Task 1.5 Final Report

The goal of the Final Report is to assess the project's success in achieving its goals and objectives, advancing science and technology, and providing energy-related and other benefits to California.

The objectives of the Final Report are to clearly and completely describe the project's purpose, approach, activities performed, results, and advancements in science and technology; to present a public assessment of the success of the project as measured by the degree to which goals and objectives were achieved; to make insightful observations based on results obtained; to draw conclusions; and to make recommendations for further RD&D projects and improvements to the PIER project management processes.

The Final Report shall be a public document. If the Recipient has obtained confidential status from the Energy Commission and will be preparing a confidential version of the Final Report as well, the Recipient shall perform the following activities for both the public and confidential versions of the Final Report.

The Recipient shall:

- Prepare an Outline of the Final Report.
- Prepare a Final Report following the approved outline and the latest version of the PIER Final Report guidelines published on the Energy Commission's website at <http://www.energy.ca.gov/contracts/pier/contractors/index.html> at the time the Recipient begins performing this task, unless otherwise instructed in writing by the Commission Project Manager. Instead of the timeframe listed in the Product Guidelines located in Section 5 of the Terms and Conditions, the Commission Project Manager shall provide written comments on the Draft Final Report within fifteen (15) working days of receipt. The Final Report must be completed on or before the end of the

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- Agreement Term.
- Submit electronic copy (MS Word and PDF versions) and one bound copy of the Final Report with the final invoice.

Products:

- Draft Outline of the Final Report
- Final Outline of the Final Report
- Draft Final Report
- Final Report

Task 1.6 Identify and Obtain Matching Funds

The goal of this task is to ensure that the match funds planned for this Agreement are obtained for and applied to this Agreement during the term of this Agreement.

The costs to obtain and document match fund commitments are not reimbursable through this Agreement. Although the PIER budget for this task will be zero dollars, the Recipient may utilize match funds for this task. Match funds shall be spent concurrently or in advance of PIER funds for each task during the term of this Agreement. Match funds must be identified in writing and the associated commitments obtained before the Recipient can incur any costs for which the Recipient will request reimbursement.

The Recipient shall:

- Prepare a letter documenting the match funding committed to this Agreement and submit it to the Commission Project Manager at least 2 working days prior to the kick-off meeting. If no match funds were part of the proposal that led to the Energy Commission awarding this Agreement and none have been identified at the time this Agreement starts, then state such in the letter. If match funds were a part of the proposal that led to the Energy Commission awarding this Agreement, then provide in the letter a list of the match funds that identifies the:
 - Amount of each cash match fund, its source, including a contact name, address and telephone number and the task(s) to which the match funds will be applied
 - Amount of each in-kind contribution, a description, documented market or book value, and its source, including a contact name, address and telephone number and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Recipient shall identify its owner and provide a contact name, address and telephone number, and the address where the property is located
- Provide a copy of the letter of commitment from an authorized representative of each source of cash match funding or in-kind contributions that these funds or contributions have been secured.

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- Discuss match funds and the implications to the Agreement if they are reduced or not obtained as committed, at the kick-off meeting. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide the appropriate information to the Commission Project Manager if during the course of the Agreement additional match funds are received.
- Notify the Commission Project Manager within 10 days if during the course of the Agreement existing match funds are reduced. Reduction in match funds must be approved through a formal amendment to the Agreement and may trigger an additional CPR.

Products:

- A letter regarding match funds or stating that no match funds are provided (no draft)
- Copy(ies) of each match fund commitment letter(s) (if applicable) (no draft)
- Letter(s) for new match funds (if applicable) (no draft)
- Letter that match funds were reduced (if applicable) (no draft)

Task 1.7 Identify and Obtain Required Permits

The goal of this task is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track.

Permit costs and the expenses associated with obtaining permits are not reimbursable under this Agreement. Although the PIER budget for this task will be zero dollars, the Recipient shall budget match funds for any expected expenditures associated with obtaining permits. Permits must be identified in writing and obtained before the Recipient can make any expenditures for which a permit is required.

The Recipient shall:

- Prepare a letter documenting the permits required to conduct this Agreement and submit it to the Commission Project Manager at least 2 working days prior to the kick-off meeting. If there are no permits required at the start of this Agreement, then state such in the letter. If it is known at the beginning of the Agreement that permits will be required during the course of the Agreement, provide in the letter:
 - A list of the permits that identifies the:
 - Type of permit
 - Name, address and telephone number of the permitting jurisdictions or lead agencies
- The schedule the Recipient will follow in applying for and obtaining these permits.

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- Discuss the list of permits and the schedule for obtaining them at the kick-off meeting and develop a timetable for submitting the updated list, schedule and the copies of the permits. The implications to the Agreement if the permits are not obtained in a timely fashion or are denied will also be discussed. If applicable, permits will be included as a line item in the Progress Reports and will be a topic at CPR meetings.
- If during the course of the Agreement additional permits become necessary, provide the appropriate information on each permit and an updated schedule to the Commission Project Manager.
- As permits are obtained, send a copy of each approved permit to the Commission Project Manager.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the Commission Project Manager within 10 days. Either of these events may trigger an additional CPR.

Products:

- Letter documenting the permits or stating that no permits are required (no draft)
- A copy of each approved permit (if applicable) (no draft)
- Updated list of permits as they change during the term of the Agreement (if applicable) (no draft)
- Updated schedule for acquiring permits as changes occur during the term of the Agreement (if applicable) (no draft)

TECHNICAL TASKS

TASK 2 MODELING AND ANALYSIS

The goal of this task is to ensure that variable speed control sequences are designed such that the evaporator does not dehumidify excessively or reach coil temperatures where condensation may freeze on the coil.

The Recipient shall:

- Prepare a Draft Modeling Report on the impact of variable fan speed on the operation of DX CRAC units.
- Prepare a Final Modeling Report on the impact of variable fan speed on the operation of DX CRAC units.

Products:

- Draft Modeling Report
- Final Modeling Report

TASK 3 DATA CENTER AUDIT AND ENERGY USAGE BASELINE

The goal of this task is to establish the energy consumption baseline of the data center. It is expected that there will be some mixing of warm and cool air in the center, causing

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the air conditioning systems to work harder than necessary. After installation of the control system, the heat load and cooling load will be balanced, leading to lower energy consumption by the air conditioners. The baseline measurements of air conditioner power are necessary to determine what the energy consumption is before the installation of the solution.

The Recipient shall:

- Perform an audit of the data center
- Collect and analyze baseline data
- Prepare a report on baseline conditions

Products:

- Report on baseline conditions (no draft)

TASK 4 PROCURE AND INSTALL VFDS

The goal of this task is to ensure the proper selection and installation of the VFDs. The VFDs must meet the following specifications:

- Proper horsepower for the fan motors
- Proper physical size for the enclosure
- Proper input and output voltage for the application
- Proper acceleration and deceleration capabilities for the application
- Proper communication capabilities for the supervisory control software
- Required ride-through for the application
- Required harmonic control and surge protection for the application

The Recipient shall:

- Install and commission VFDs
- Prepare a written report regarding installation of VFDs

Products:

- VFD Installation Report (no draft)

TASK 5 INSTALL AND COMMISSION DASH SYSTEM

The goal of this task is to ensure proper operation of the Datacenter Automation Software and Hardware (DASH) system. This will entail making sure the temperature sensors are successfully sending signals to the server, and the data is read into the proper registers correctly. In addition, the DASH software must successfully send signals to the air conditioner and the VFDs. Air conditioner setpoint control and VFD speed control should be demonstrated during the commissioning efforts.

The Recipient shall:

- Install DASH hardware and software
- Perform commissioning to ensure proper operation
- Prepare written report regarding operation of DASH system

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Products:

- Dash System Operations Report (no draft)

TASK 6 AIRFLOW MANAGEMENT

The goal of this task is to optimize airflow in the system. With the DASH system operational, the software will be able to control air conditioner operation and fan speed to balance the airflow with the heat load. As the software executes control algorithms, it will determine the effectiveness of various settings, thereby settling on the most effective solution. Ultimately, the mixing of warm and cool air will be minimized, and the heat transfer from the servers to the air conditioners will be maximized. Thermal maps will provide end-users with a measure of the effects of the control, and the reduction in power consumption will be the ultimate result.

The Recipient shall:

- Block openings to prevent air bypass
- Adjust operating set points

Products:

- NONE

TASK 7 MEASUREMENT AND VERIFICATION (M&V) TESTS

The goal of this task is to document performance of the system regarding energy savings.

The Recipient shall:

- Prepare the Test Plan. The Test Plan shall include, but is not limited to:
 - A description of the process to be tested
 - The rationale for why the tests are required
 - Predicted performance based on calculation or other analyses
 - Test objectives and technical approach
 - A test matrix showing the number of test conditions and replicated runs
 - A description of the facilities, equipment, instrumentation required to conduct the tests
 - A description of the test procedures, including parameters to be controlled and how they will be controlled, parameters to be measured and instrumentation to measure them, calibration procedures to be used, recommended calibration interval, and maintenance of the test log
 - A description of the data analysis procedures
 - A description of the quality assurance procedures
 - Contingency measures if the test objectives are not met

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- Prepare the Test Report. The Test Report shall include, but is not limited to the following:
 - The Test Plan
 - Test results
 - Analysis
 - Pre and post retrofit energy use and resulting energy and cost savings
 - Conclusions
 - Recommendations
 - Photographs as appropriate
- Participate in a CPR as per Task 1.2

Products:

- M&V Test Plan (no draft)
- Draft M&V Test Report
- Final M&V Test Report

TASK 8 TECHNOLOGY TRANSFER ACTIVITIES

The goal of this task is to develop a plan to make the knowledge gained, experimental results and lessons learned available to key decision-makers.

The Recipient shall:

- Prepare a Technology Transfer Plan. The plan shall explain how the knowledge gained in this project will be made available to the public. The level of detail expected is least for research-related projects and highest for demonstration projects. Key elements from this report shall be included in the Final Report for this project.
- Conduct technology transfer activities in accordance with the Technology Transfer Plan. These activities shall be reported in the Monthly Progress Reports.

Products:

- Draft Technology Transfer Plan
- Final Technology Transfer Plan